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Abdominal circumference ratio for the diagnosis of intertwin birth weight discordance

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Abstract

Objectives: We assessed the accuracy of predicting severe twin birth weight discordance (>25%) using the estimated fetal weights (EFW) and abdominal circumference (AC) ratio.

Method: A cohort of twin gestations underwent ultrasound examinations within two weeks from birth. We focused on the accuracy of EFW and on the diagnosis of severe birth weight discordance by the difference in EFWs and the AC ratio.

Results: The 661 eligible twin pairs included 51 (7.7%) severely discordant pairs. The accuracy of an EFW to predict the actual birth weight was quite poor, with an acceptable specificity (96.4%), but low sensitivity (28.6–40.5%), to detect severely discordant pairs, whereas an AC ratio of 1.3 detected these discordant pairs with sensitivity and specificity of 97.3–100% and 99.6–99.7%, respectively.

Conclusion: By comparing EFWs, 59.5–71.4% of discordant pairs >25% are missed, whereas an AC ratio >1.3 would identify almost all cases.

Keywords: Abdominal circumference ratio; birth weight discordance; estimated fetal weight; twins; ultrasound.

Introduction

The prenatal diagnosis of growth discordant twins was attempted since the early days of ultrasonography. For example, in 1977 Houlton compared the biparietal diameters (BPD) in 28 pairs and was able to detect divergent growth in 61% of the pairs [13]. In the following three decades, during which the clinical implications of discordant growth of twins has been clarified [3], fetal weight discordance

became an integral part of the prenatal assessment of twins. These attempts are apparent from hundreds of studies trying to establish the accuracy of sonographic prediction of birth weight discordance. At present, the best estimate of discordant growth comes from calculating paired estimated fetal weights (EFWs) and deriving the discordance level by the same way it is derived from actual birth weights [5]. At the same time, however, it became clear that even with a relatively accurate EFW (within $\pm 10\%$ of the actual birth weight) calculated for each fetus, the “ $\pm$ ” situation may involve significant error in estimating birth weight discordance with both “diverging” and “converging” estimations.

Over the years, two more related issues became apparent [4]. First, that lower levels of birth weight discordance probably represent an intertwin natural variation and that the level likely to represent aberrant growth is at least 25% [8]. Second, that as many as 40% of severely discordant twins (i.e., birth weight discordance >25%) do not represent significant growth restriction because the smaller twin is not small-for-gestational age (SGA, birth weight <10th percentile for gestational age) [1, 6]. It follows that once discordant growth is suspected, one should differentiate between the “normal” and the “abnormal” (i.e., with and without the smaller twin being SGA) severely discordant pairs. Currently, there are no data to show how accurate are sonographic measurements in identifying these abnormally discordant pairs.

One way to reduce the inherent method error of estimating intertwin discordance was to compare the abdominal circumference (AC). In the mid-80s several AC differences were suggested as adjuncts to the EFW difference to detect discordant twin growth [7, 15]. However, the absolute AC difference seems to be gestational age dependant and, therefore, could not significantly improve the accuracy of estimating birth weight discordance [9]. More recently, a Canadian study [14] calculated the AC ratio in a cohort of diamniotic twin gestations. A total of 64 pregnancies (12.7%) had discordant birth weights >25% and an AC ratio cut-off of 0.93 yielded a sensitivity and specificity of 61% and 84%, respectively.

In the present study, we assessed the accuracy of the AC ratio and the EFW difference in predicting concordant twins, and in differentiating discordant pairs in which the smaller twin was or was not SGA.

Methods

This is a study of sonographic measurements in twins prospectively collected between January 1, 1994 and June 30, 2008 in the tertiary maternity center Alfredo da Costa, Lisbon, Portugal. During this period, information about the pregnancy and delivery was prospectively registered on a preset form and subsequently entered into a computerized system. We included in the present assessment all

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twin gestations irrespective of chorionicity, in which paired sonographic measurements were performed within two weeks before birth and both twins were born alive at our hospital. All other pairs were excluded. During this period, we used several ultrasound machines, but the measurements were performed by the same standardized method and by the same operators (Portuguese authors). EFW was calculated automatically by the sonographic machine using the ASTRALIA software (Astraia software GmbH, Munich, Germany) and the inbuilt formula of Hadlock (based on AC and femur length). The AC was measured at the level of the bifurcation of the main portal vein, taking care of depicting as round a section as possible. Measurements of each parameter were done three times and the average was used for calculations. In this study, twin A was the presenting twin.

This study focused on three questions. (1) The accuracy of EFW as compared to the actual birth weight for each of the twins. We defined an accurate EFW as one within $\pm 10\%$ from the actual birth weight, and calculated the frequency of an EFW exceeding this value. (2) The predictive values of the difference in EFWs to establish an accurate diagnosis of severe ($>25\%$) birth weight discordance. (3) The accuracy of the AC ratio (AC of larger twin/AC of smaller twin) in predicting birth weight discordance. We evaluated three ratios: $>10\%$ difference (ratio >1.1), $>20\%$ difference (ratio of >1.2), $>30\%$ difference (ratio of >1.3). The primary hypothesis was that the AC ratio might be a better predictor of severe discordance.

Discordance level was calculated from the difference between EFWs or birth weights divided by the BFW or birth weight of the larger twin and expressed as a percentage. The severely discordant pairs were further subdivided into pairs in which the smaller twin was either SGA (SGA discordant) or not SGA [appropriate-for-gestational age (AGA) discordant]. SGA status was calculated from Portuguese twin birth weight by gestational age charts (unpublished). The study was approved by the local Institutional Review Board.

We used the True EPISTAT Software (Math Archives, Round Rock, TX, USA) to compare frequencies by the Fisher's exact. We derived odds ratio (OR) and Corenfield's 95% confidence intervals (CI). Continuous variables were compared by Student's *t*-test, with *P*-value <0.05 considered significant. Sensitivity was calculated from the number of true positive values divided by the sum of true positive plus and false negative values, whereas specificity was calculated from the number of true negatives divided by the sum of true negative and false positive values.

Results

The results from 661 twin pairs were eligible for the study, comprising 610 concordant ($<25\%$) and 51 (7.7%) severely

discordant pairs. Table 1 shows that pregnancies with concordant pairs had similar characteristics compared to pregnancies with AGA discordant twins. In contrast, SGA discordant pairs had a significantly lower ($P<0.05$) mean maternal age, mean gestational age of last sonography, and mean gestational age at birth compared to both concordant and AGA discordant pairs.

Table 2 shows that the accuracy of an EFW to predict the actual birth weight was poor for twin A with significantly more AGA discordant twins being wrongly estimated ($>10\%$ of actual birth weight) compared to the other two groups. These values were somewhat better for twin B with about 50% accurate EFWs in all three groups. Whereas the specificity was quite good to detect both groups of discordant pairs, the sensitivity was quite low.

Table 3 shows the accuracy of the three AC ratios in predicting discordance. It appears that almost half of the concordant twins have at least a 10% difference (AC ratio of 1.1). When a higher cut-off value was chosen (i.e., ratio of 1.2 and 1.3), both sensitivity and specificity reached nearly 100%.

Discussion

The prediction of intertwin birth weight discordance by sonography has been extensively studied [5]. Discordance, especially if severe, seems to be a trigger for looking at growth aberration of the twins, and in particular, growth restriction of the smaller twin. Very different predictive results can be found among the numerous papers, but the overall impression is that prediction of discordant growth by comparing EFWs is not accurate for clinical use [4, 5]. This statement is based on two observations. First, probably because of fetal crowding in twin gestations, it seems more difficult to obtain an accurate EFW for an individual twin compared with singletons [12]. This observation was supported by our study (Table 2). Second, even with accurate EFWs (i.e., within $\pm 10\%$ from the actual birth weight) it is inherently difficult to obtain an accurate discordance level. The decade-old conclusion reached in the review of Caravella and co-workers, is still relevant today: most popular methods (difference in AC or EFW) for predicting discordant growth in twin gestations have limited accuracy for discor-

Table 1 Maternal age and gestational age at last sonography and at birth.

	Concordant	Discordant ($>25\%$)	
		AGA	SGA
n (%)	610 (92.4)	14 (2.1)	37 (5.6)
Mean maternal age (years)	30.4 $\pm$ 5.2	30.5 $\pm$ 4.7	27.8 $\pm$ 4.6 ^a
Gestational age at last sonography (weeks)	34.0 $\pm$ 2.4	34.0 $\pm$ 1.3	32.6 $\pm$ 2.6 ^a
Gestational age at birth (weeks)	35.6 $\pm$ 2.2	35.7 $\pm$ 1.0	33.5 $\pm$ 2.7 ^a

Data presented as mean $\pm$ standard deviation.

^aSGA discordant twins vs. concordant and AGA discordant twins, $P<0.05$.

AGA = appropriate-for-gestational age, SGA = small-for-gestational age.

Table 2 Estimated fetal weight (EFW) difference in predicting birth weight discordance.

	Concordant (n=610)	Discordant (> 25%)	
		AGA (n=14)	SGA (n=37)
EFW, twin A (g)	2104±486	2168±314	1739±520
Birth weight, twin A (g)	2316±466	2824±545	1907±513
Accurate EFW (<10% error)	310/610 (50.8) ^a	2/14 (14.3) ^{a,b}	15/37 (40.5) ^b
EFW, twin B (g)	2145±483	2175±462	1529±484
Birth weight, twin B (g)	2274±470	2328±401	1565±537
Accurate EFW (<10% error)	330/610 (54.1)	6/14 (42.8)	18/37 (48.6)
Estimated discordance < 25%	588 (96.4)	10 (71.4)	22 (59.4)
Estimated discordance > 25%	True negative, 22	True positive, 4	True positive, 15
Sensitivity (%)		28.6	40.5
Specificity (%)		96.4	96.4

Data presented as n (%) and as mean±standard deviation. Predictive values were calculated by separate comparisons of AGA and SGA discordant to concordant twins.

^aOR 0.2, 95% CI 0.04, 0.8.

^bOR 0.1, 95% CI 0.01, 0.8.

AGA=appropriate-for-gestational age, SGA=small-for-gestational age, OR=odds ratio, CI=confidence interval.

dance level of at least 25% [10]. It is, therefore, necessary to find ancillary means to improve the prediction of discordance.

In our sample of twins a ratio of 1.3 between paired ACs predicts severe birth weight discordance with very high sensitivity and specificity values. Our cut-off AC ratio is different than that proposed by Klam et al. [14], but we obtained much higher sensitivity and specificity values compared to those found by these authors. Moreover, this ratio was as good in predicting severely discordant pairs with and without an SGA smaller twin. Thus, although this ratio is an excellent predictor of severe discordance, it cannot differentiate between the two entities.

One limitation of our study is the low frequency of severe discordance (7.7%). This value, however, is in accord with the frequencies found in nearly 125,000 American twin pairs

[5] but reduces the power of the analysis. On the other hand, our study is among the largest of its kind, and comes from a single center, with a protocol of ultrasound assessment that did not change over time.

Another limitation of our study, as in most other studies, is that all methods for estimating discordance are in fact capturing the situation at a stage within one to two weeks from birth. Such methods, in fact, do not predict severe discordance but rather diagnose it before birth. Attempts to predict discordance by ultrasound measurements of fetal growth velocity and size during the early weeks of the third trimester were poor predictors of birth weight discordance [2, 11]. Although Hadlock's formula using the femur length and AC might underestimate the true birth weight, it is expected to do so for both twins and thus unlikely to reduce the accuracy of estimated discordance.

The question may arise if such a diagnosis is not reached too late, and hence there is need to assess the ability of the AC ratio obtained in the early third trimester to predict the subsequent development of severe discordance. It is also possible that fetuses may continue to grow in the last two weeks before birth and therefore reduce the accuracy of predicting discordance. However, we feel it is unlikely that a difference generated within the last two weeks will cause severe discordance in mildly discordant twins or would mistakenly consider one twin as SGA. Using the extremes (severe discordance and being SGA) may decrease the potential methodological inaccuracy. Because we used the last sonographic measurement, we were unable to count how many pairs were close to but less than 25% discordance at two weeks before birth but were discordant at birth. Thus, counting them as false negative cases might be incorrect given the potential for a true diagnosis had another measurement been done.

Regardless of these reservations, our data suggest that with the current method of comparing EFWs, 60–70% of severely discordant pairs are missed, whereas the finding of an AC ratio > 1.3 would identify almost all cases.

Table 3 Abdominal circumference (AC) ratio predicting birth weight discordance.

	Concordant (n=610)	Discordant (> 25%)	
		AGA (n=14)	SGA (n=37)
Ratio > 1.1	253	9	23
Sensitivity (%)		58.5	31.8
Specificity (%)		35.7	37.8
Ratio > 1.2	4	14	32
Sensitivity (%)		100	86.5
Specificity (%)		99.3	99.3
Ratio > 1.3	2	14	36
Sensitivity (%)		100	97.3
Specificity (%)		99.6	99.7

Data presented as n (%). Predictive values were calculated by separate comparisons of AGA and SGA discordant to concordant twins. AGA=appropriate-for-gestational age, SGA=small-for-gestational age.